Experimental Hepatology Laboratory

At the Experimental Hepatology group, we focus on toxic liver damage, hepatoprotection, liver regeneration, and, more recently, Metabolic Dysfunction-Associated Steatotic Liver Disease (MASLD).

The liver is the main metabolic organ that coordinates whole-body homeostasis and serves as the primary site for the biotransformation of xenobiotics and various endogenous substances. Liver mitochondria play a crucial role in these processes, and their dysfunction accompanies most liver pathologies. MAFLD is considered the hepatic manifestation of metabolic syndrome and is currently the most common chronic liver disease. Some authors even consider MAFLD a mitochondrial disease. Studying mitochondrial function and the possibility of its modulation is, therefore, essential for understanding pathological mechanisms and exploring diagnostic and therapeutic options for liver diseases.

Our department uses various model systems to study liver function, including liver homogenate, isolated mitochondria, isolated hepatocytes, stabilized, and cancer cell lines—each with its advantages and limitations. Recently, evidence has emerged suggesting that the energy metabolism of platelets reflects the overall metabolic state of the organism/body, including liver function. Since platelets, unlike liver tissue, are easily accessible biological material, assessing their energy state could be important for diagnosing liver damage and monitoring the effects of potential therapies. To evaluate mitochondrial function, it is essential to have the necessary equipment and standardized protocols harmonized with other laboratories.

Our laboratory has been equipped with three Oroboros-2k oxygraphs. By using a suitable combination of different substrates, uncouplers, and specific inhibitors, the oxygraph enables the assessment of various energy pathways, individual respiratory complexes, and functions (such as the respiratory control index, ATP production intensity, and the integrity of the outer and inner mitochondrial membranes). By combining the oxygraph with fluorescent sensors, we can also evaluate mitochondrial membrane potential, reactive oxygen species production, and calcium retention capacity. However, a limitation of this device is that it allows simultaneous analysis of only two samples per oxygraph and does not support the analysis of adherent cells.
Thanks to the Core Facilities project, we have previously expanded our unique equipment with an **Agilent Seahorse Bioscience XFe96 analyzer** for cellular metabolic analysis. Its advantage lies in the ability to simultaneously analyze adherent samples in 96-well plates while assessing both mitochondrial respiration and glycolysis intensity. However, the limitation is a small number of substrate additions, which limits more detailed analysis. Therefore, the ideal approach is to combine both methods.Recently, through the Ph.D. Infra for CU project, we have also acquired the **NextGen-O2k device**, which is compatible with our oxygraphs. This upgrade will enable us to analyze eight samples simultaneously, which is crucial given the time-intensive nature of these analyses. The device is also equipped with a **Q-module**, allowing the simultaneous assessment of the redox state of coenzyme Q using cyclic voltammetry. Coenzyme Q plays a key role in the respiratory chain, and changes in its redox state have been linked to various pathologies.

All our instruments are also available to other departments for the analysis of energy parameters in various cell types and tissues.

Agilent Seahorse Bioscience XFe96 Analyzer Power Pak

Supplier	HPST, s.r.o.
Acquisition year	2018
Price	7.6 million CZK incl. VAT
Funding	P RDE CORE FACILITIES CZ.02.1.01/0.0/0.0/16_017/0002515
Person responsible	doc. MUDr. Otto Kučera, Ph.D.

Oroboros NextGen-O2k Startup, Series XB vč. O2k-Q-Module

Supplier	Oroboros Instruments GmbH
Acquisition year	2025
Price	2.9 million CZK incl. VAT

Funding	P JAC Ph.D. Infra for CU CZ.02.01.01/00/22_012/0005514
Person responsible	Mgr. Pavla Staňková, Ph.D.